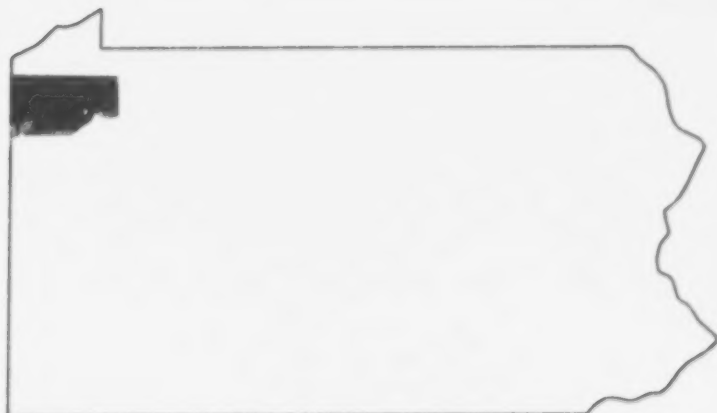


JUL 13 1990

FLOOD INSURANCE STUDY



TOWNSHIP OF
HAYFIELD,
PENNSYLVANIA
CRAWFORD COUNTY



AUGUST 2, 1990



Federal Emergency Management Agency

COMMUNITY NUMBER - 421227

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision (LOMR) process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Flood Insurance Study Effective Date: August 2, 1990

Flood Insurance Study Revised:

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FLOOD INSURANCE STUDY
TOWNSHIP OF HAYFIELD, CRAWFORD COUNTY, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Hayfield, Crawford County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by the Pittsburgh District of the U. S. Army Corps of Engineers (COE) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-86-E-2226, Project Order No. 2. This work was completed in July 1988.

1.3 Coordination

On May 20, 1985, an initial Consultation and Coordination Officer's (CCO) meeting was held with representatives of FEMA, the Crawford County Planning Commission, and the COE (the study contractor) to determine the streams to be studied by detailed methods. Township officials were not able to attend this meeting; therefore, study limits were determined using input from the Crawford County Planning Commission.

On September 18, 1989, a final CCO meeting was held with representatives of FEMA, the township, and the study contractor to review the results of the study.

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2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Hayfield, Crawford County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

French Creek was studied by detailed methods for its entire length within the community. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through July 1993.

Cussewago Creek, Wolf Run, and an unnamed stream were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the Township of Hayfield.

2.2 Community Description

The Township of Hayfield is located in central Crawford County in northwestern Pennsylvania. It is bordered by the Townships of Cussewago and Venango to the north, the Borough of Saegertown and the Townships of Woodcock and West Mead to the east, the Township of Vernon to the south, and the Townships of Summit and Summerhill to the west. The township has a land area of 39.3 square miles, and lies approximately 5 miles west of the City of Meadville. The population of the township was 2,969 in 1980, a 37 percent increase from 2,162 in 1970 (Reference 1).

French Creek has a total drainage area of approximately 1,235 square miles at its confluence with the Allegheny River, which it joins on the right bank at river mile 123.9, at the City of Franklin. It flows towards the southwest from its source near Chautauqua County, New York. The average stream gradient is approximately 4 feet per mile. The average hilltop elevation is 1,770 feet in the headwaters and 960 feet at its mouth. The average bed slope in the township is 5 feet per mile. Local relief above the stream varies from a low of 1,070 feet to a high of 1,240 feet. The valley floor varies from 500 to 2,500 feet in width.

The climate for the Township of Hayfield and its surrounding area is temperate, with the normal seasonal variation in temperature. The area is geographically located in a region of variable air-mass activity, and is subjected to polar and tropical, continental and maritime air-mass invasions. The weather is usually moderate, but is subject to frequent and rapid changes as a result of air-mass movement. Temperatures range from an average of 27 degrees Fahrenheit ($^{\circ}\text{F}$) in February to an average of 71 $^{\circ}\text{F}$ in July. Precipitation occurs on the average of 150 days per year, with an average annual precipitation of approximately 40 inches.



FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF HAYFIELD, PA
(CRAWFORD CO.)

APPROXIMATE SCALE



VICINITY MAP

2.3 Principal Flood Problems

Major floods may occur along French Creek at various times of the year. Floods occurring in the winter months are usually the result of heavy rainfall and snowmelt. Floods occurring during the summer months are usually the result of high intensity, short duration storms. French Creek is subject to considerable ice gorging, but those effects were not considered in this study.

The maximum flood of record along French Creek within the Township of Hayfield occurred in January 1959. This flood reached a height of approximately 1,108 feet at the COE wire weight gage located on the old State Route 19 bridge over French Creek, in the Borough of Saegertown. Other known floods occurred in March 1913, April 1947, March 1960, March 1964, and September 1967.

2.4 Flood Protection Measures

There are two flood-control dams and reservoirs upstream of the Township of Hayfield that are effective in reducing flood levels in the township. Union City Reservoir, completed in October 1970, has an earthen dam, which is located on the main stem of French Creek, approximately 38 miles upstream of the township or at creek mile 71.5. It is a dry-bed reservoir with a capacity of approximately 47,600 acre-feet of storage and a drainage area of approximately 222 square miles. Woodcock Creek Lake, completed in January 1974, is on the main stem of Woodcock Creek and is located 3.6 miles upstream of the mouth of Woodcock Creek. It is a multipurpose reservoir with flood control storage of 18,900 acre-feet in winter and 15,250 acre-feet in summer, and a drainage area of approximately 46 square miles. The present reservoir system reduces flood crests in the township by approximately 1 to 3 feet. They control approximately 27 percent of the drainage area upstream of the Township of Hayfield.

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. A flood event of a magnitude which is expected to be equaled or exceeded once on the average during any 100-year period (recurrence interval) has been selected as having special significance for floodplain management and for flood insurance rates. This event, commonly termed the 100-year flood, has a 1 percent chance of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to

approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding source studied in detail affecting the community.

Natural discharge frequency curves on French Creek were developed using stream gage records obtained at the U. S. Geological Survey (USGS) gaging station at Utica (No. 3024000) and the COE gage at Meadville. Continuous recording gage records at the USGS gaging station at Utica are available from August 1932 to the present. The COE has had numerous staff, chain, or wire weight gages on French Creek at Meadville and in the basin for varying periods of time extending back to April 1908. Records of stream gage on French Creek at Meadville have been collected at the National Weather Service (NWS) staff gage since October 1937. This gage, however, was not considered in this analysis. The historical flood records for the French Creek gaging stations were analyzed using the standard log-Pearson Type III analysis outlined in USGS Bulletin 17B (Reference 2). Flood-flow frequencies developed for French Creek were modified by means of an average reduction curve to reflect the reduction in drainage area by the upstream flood-control reservoirs. The flows developed were verified by the NWS Dam-Break Flood Forecasting Model (Reference 3).

A summary of the drainage area-peak discharge relationships for the stream studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

<u>FLOODING SOURCE AND LOCATION</u>	<u>DRAINAGE AREA (sq. miles)</u>	<u>PEAK DISCHARGE (cfs) 100-YEAR</u>
FRENCH CREEK		
At downstream corporate limits	688	25,000
Upstream of confluence of Woodcock Creek	600	24,000

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross-sectional data were obtained from topographic mapping and, as needed, were interpolated by the computer program (Reference 4). In addition, more defined channel cross sections were obtained from discharge measurements at COE stream gaging stations located along French Creek in the Boroughs of Saegertown, Venango, and Cambridge Springs.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1) and the Flood Insurance Rate Map (Exhibit 2) where applicable.

Water-surface elevations of floods of the selected recurrence intervals for French Creek, from the downstream corporate limits to creek mile 35.51, were obtained from the Flood Insurance Study for the Township of West Mead (Reference 5). For the remaining portion of French Creek, water-surface elevations were computed using the NWS Dam-Break Flood Forecasting Model (Reference 3). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations on French Creek were obtained from a continuation of profile developed for the Flood Insurance Study for the Township of West Mead (Reference 5). The reasonableness of the computed water-surface elevations was verified by comparing them to the well-defined floods of January 1959, March 1960, and September 1967 as well as the rating curves developed from discharge measurements and high water marks obtained at the COE gaging stations. The results of the water-surface computations are tabulated for the selected cross sections for each stream segment (Tables 2 and 3).

Bridges and their resulting effects on the water-surface elevations are not considered directly in the NWS computer program; however, bridge losses are generally included within the roughness coefficients. Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen based on channel characteristics and comparisons with completed studies in the French Creek basin. The channel "n" value for French Creek was 0.045, and the overbank "n" value was 0.070.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

FLOODING SOURCE		STREAM CHANNEL			LEFT OVERBANK			RIGHT OVERBANK			100 YEAR FLOOD WATER SURFACE ELEVATION (NGVD)
CROSS SECTION	DISTANCE ¹ MILES	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	
A	33.46	320	25,000	6.27	-	-	-	-	-	-	1,087.07
B	34.07	1,475	25,000	4.69	-	-	-	-	-	-	1,089.83
C	34.36	446	24,675	5.67	-	-	-	295	325	0.88	1,091.04
D	35.51	255	24,919	8.14	-	-	-	25	81	1.60	1,097.95

¹miles above mouth

TABLE 2	FEDERAL EMERGENCY MANAGEMENT AGENCY	REGULATORY DATA
	TOWNSHIP OF HAYFIELD, PA (CRAWFORD COUNTY)	FRENCH CREEK

FLOODING SOURCE		RIVER CHANNEL				BASE FLOOD ELEVATION
CROSS SECTION	DISTANCE ¹ MILES	SECTION AREA (SQ. FT.)	DISCHARGE (C.F.S.)	MEAN VELOCITY (F.P.S.)	STREAM-BED ELEVATION FT. (HOVD)	FT. (HOVD)
E	36.28	4,237.3	25,000	5.9	1,086.0	1,105.29
F	37.71	6,857.1	24,000	3.5	1,092.0	1,110.92
G	39.6	4,363.6	24,000	5.5	1,103.0	1,122.33
H	41.54	5,454.5	24,000	4.4	1,112.0	1,130.94

¹miles above mouth

TABLE 3	FEDERAL EMERGENCY MANAGEMENT AGENCY	100-YEAR FLOOD DATA
	TOWNSHIP OF HAYFIELD, PA (CRAWFORD COUNTY)	FRENCH CREEK

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100-year floodplain boundaries to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. For the streams studied in detail, the 100-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 10 feet (Reference 4).

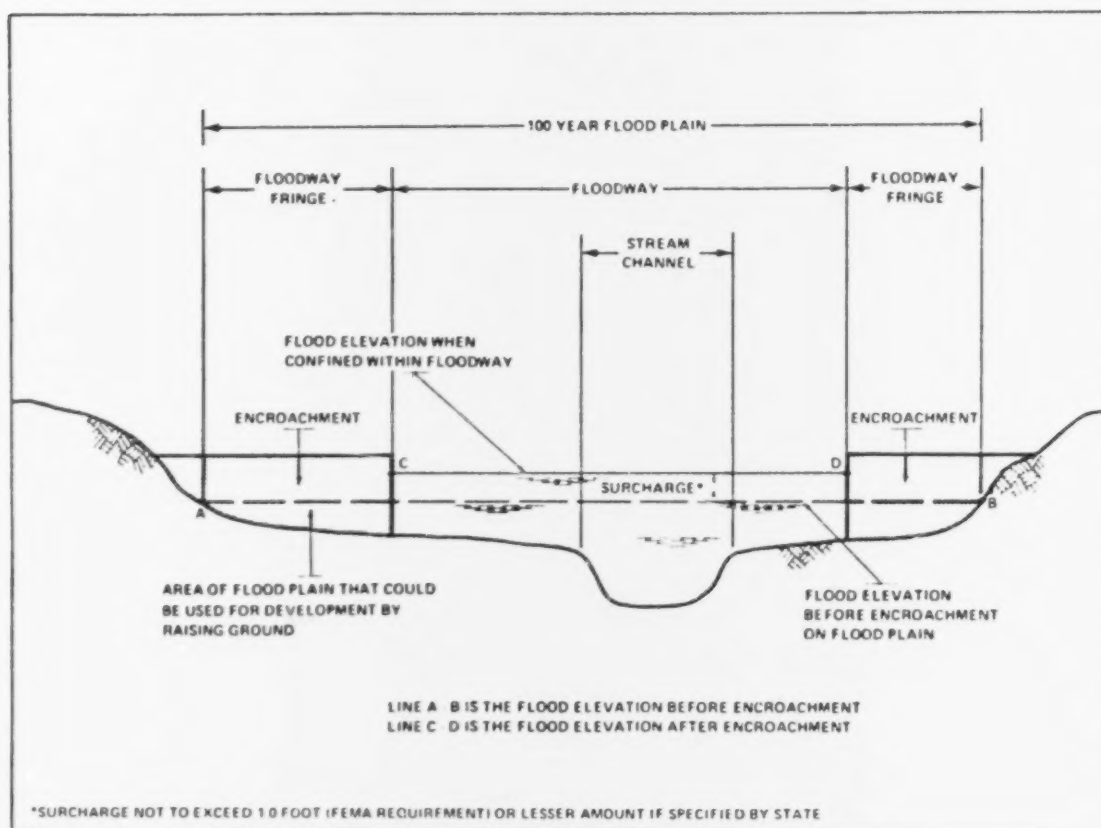
For the streams studied by approximate methods, the 100-year floodplain boundaries were delineated using the Flood Hazard Boundary Map for the Township of Hayfield (Reference 6).

The 100-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE). Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.



FLOODWAY SCHEMATIC

Figure 2

No floodways were calculated as part of this study.

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths

Zone X (continued)

are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100-year floodplain. The locations of selected cross sections used in the hydraulic analyses are shown where applicable.

7.0 OTHER STUDIES

Flood Insurance Studies have been prepared for the Townships of West Mead, Vernon, and Woodcock, and the Borough of Saegertown (References 5, 7, 8, and 9). The results of this study are in exact agreement with the results of those studies.

Due to its more detailed nature, this study supersedes the Flood Hazard Boundary Map for the Township of Hayfield (Reference 6).

The COE has prepared a Flood Plain Information Report for the City of Meadville (Reference 10). That report includes French Creek from mile 24.5 to mile 35.5 and approximately 5.5 miles of Cussewago Creek. Due to changes in flow quantities as a result of the upstream flood control structures, the 100-year frequency flood elevations presented in this Flood Insurance Study do not agree with those presented in that Flood Plain Information Report.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

9.0 BIBLIOGRAPHY AND REFERENCES

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2. U. S. Department of the Interior, Geological Survey, Office of Water Data Collection, Interagency Advisory Committee on Water Data, "Guidelines for Determining Flood Flow Frequency," Bulletin 17B, Reston, Virginia, Revised September 1981.
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8. Federal Emergency Management Agency, Flood Insurance Study, Township of Woodcock, Crawford County, Pennsylvania, Washington, D. C., June 18, 1990.
9. Federal Emergency Management Agency, Flood Insurance Study, Borough of Saegertown, Crawford County, Pennsylvania, Washington, D. C., June 18, 1990.
10. U. S. Army Corps of Engineers, Pittsburgh District, Flood Plain Information Report, French and Cussewago Creeks, Meadville, Crawford County, Pennsylvania, Pittsburgh, Pennsylvania, June 1969.

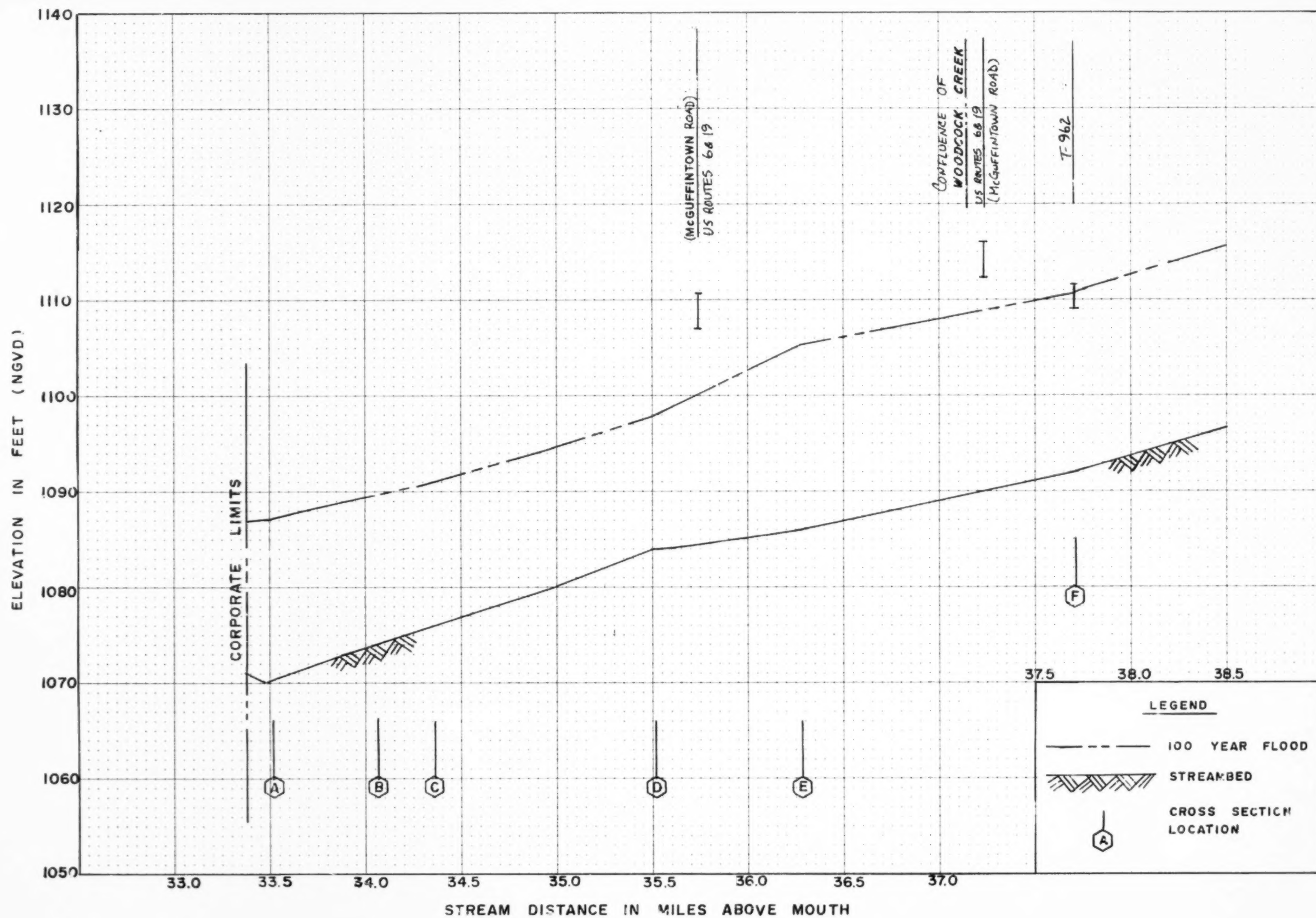
EXHIBIT 3 - ELEVATION REFERENCE MARKS

<u>Reference Mark</u>	<u>FIRM Panel</u>	<u>Elevation (Feet NGVD)</u>	<u>Description of Location</u>
RM 1	*	1,094.24	Standard disk, stamped M62 1935, approximately 2.1 miles north along CONRAIL from station at Meadville, approximately 0.4 mile south of milepost 100, approximately 148 feet northeast of center of private road crossing, at bridge No. 100.35, in south corner of east headwall, approximately 70.5 feet east of east rail of eastbound track, approximately 19 feet east of centerline of road paralleling track, and approximately 29.6 feet north of first telegraph pole north of crossing.
RM 2	*	1,109.39	COE disk, stamped 253 1935, approximately 3.1 miles north along CONRAIL from station at Meadville, approximately 0.4 mile south of milepost 99, at bridge No. 99.34, in south corner of west abutment, approximately 2.6 feet southwest of southwest corner of steel bridge wall, approximately 2 feet north of south end of abutment, approximately 6 feet south of south rail of eastbound track, and approximately 1 foot lower than track.
RM 3	18	1,113.42	PDOT disk located on upstream left bank abutment of State Routes 6 and 19 (McGuffintown Road) bridge over French Creek.
RM 4	18	1,116.10	PDOT disk set on left bank abutment of State Routes 6 and 19 bridge over French Creek.
RM 5	18	1,111.25	Square cut in top of downstream right bank wing wall of T-962 bridge over French Creek.
RM 6	18	1,121.09	PDOT disk set in top of southwest wing wall of State Route 198 bridge over Wolf Run.
RM 7	18	1,121.07	PDOT disk set in right bank downstream wing wall of State Route 198 bridge over French Creek.

*Located outside corporate limits; not shown on maps.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

<u>Reference Mark</u>	<u>FIRM Panel</u>	<u>Elevation (Feet NGVD)</u>	<u>Description of Location</u>
RM 8	19	1,127.17	Cross cut in right bank upstream wing wall of US Routes 6 and 19 (Broadford Bridge Road) bridge over French Creek.

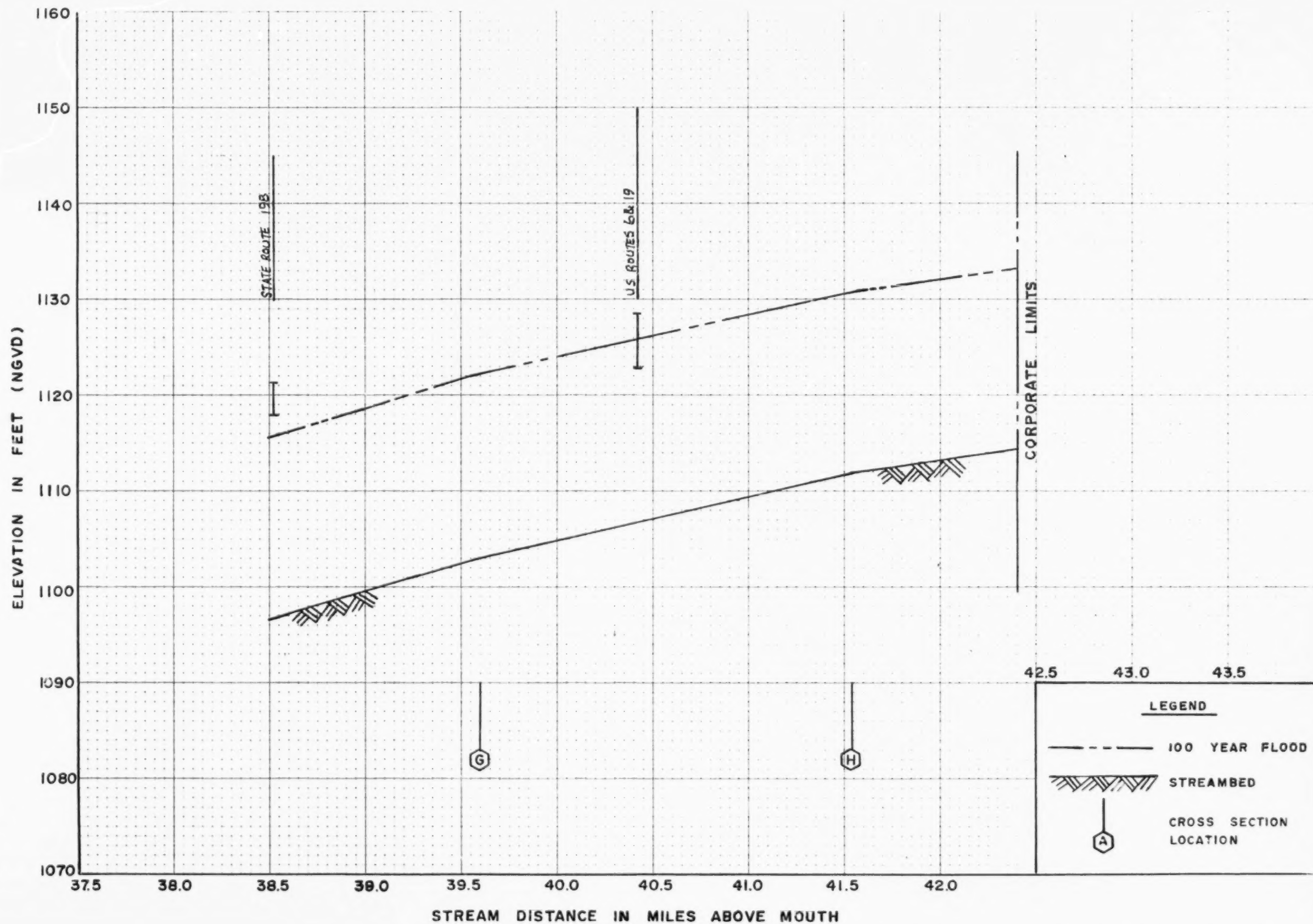


FLOOD PROFILES

FRENCH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
TOWNSHIP OF HAYFIELD, PA
(CRAWFORD COUNTY)

01P



FEDERAL EMERGENCY MANAGEMENT AGENCY
TOWNSHIP OF HAYFIELD, PA
 (CRAWFORD COUNTY)

FLOOD PROFILES
FRENCH CREEK

02P

17